National Aeronautics and Space Administration
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# Cold month precipitation is underestimated more than 50% over Tibetan plateau (Ali Behrangi)

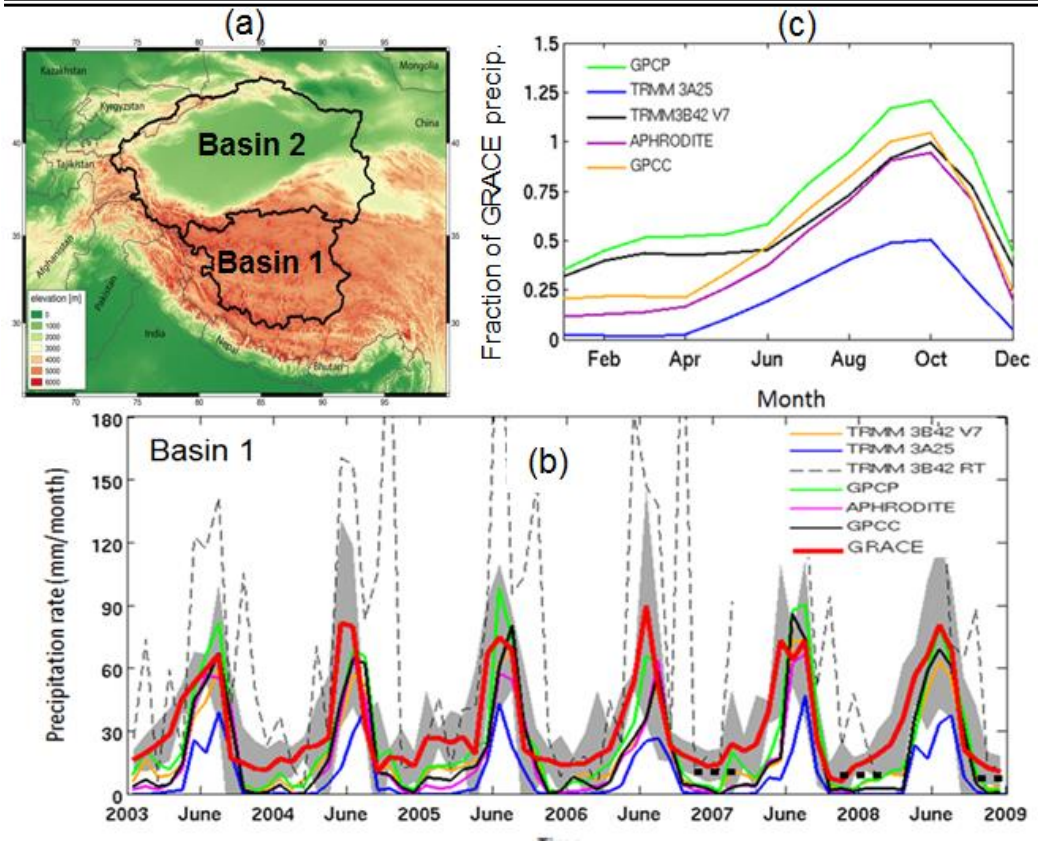



**Figure caption:** Comparison of monthly precipitation accumulation from several precipitation products over an Endorheic basin (Basin 1 ; see panel a) in Tibetan plateau. Precipitation estimate using mass balance equation and GRACE (red line in panel b with gray shades representing 2σ uncertainties) suggests that current precipitation products (including GPCP) significantly underestimate cold month precipitation amount(i.e., >50% of monthly precipitation; panel c) . The black dashed lines in (b) represent winter mean snowfall rate from CloudSat available since 2007.

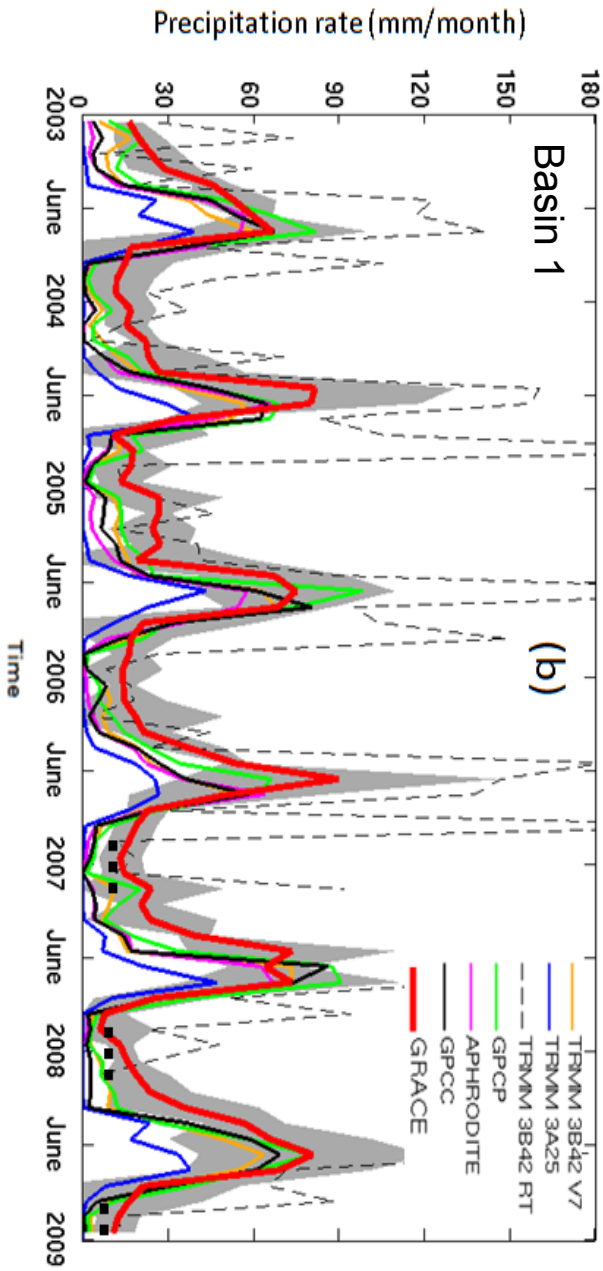
**Problem:** Current precipitation measuring sensors and retrieval methods are not skillful for estimating precipitation over cold mountainous regions.

**Finding:** Independent observations from GRACE and CloudSat (that are not designed for precipitation estimation) help identify potential biases in popular precipitation products. This study estimates monthly precipitation based on an independent technique (gravimetry versus radiometry)

**Significance:** includes (1) more accurate estimate of local water resources, (2) advancing regional and global water and energy budget calculation, (3) constraining biases of other precipitation products in cold months when precipitation products are most uncertain and ground measurements often lacking.

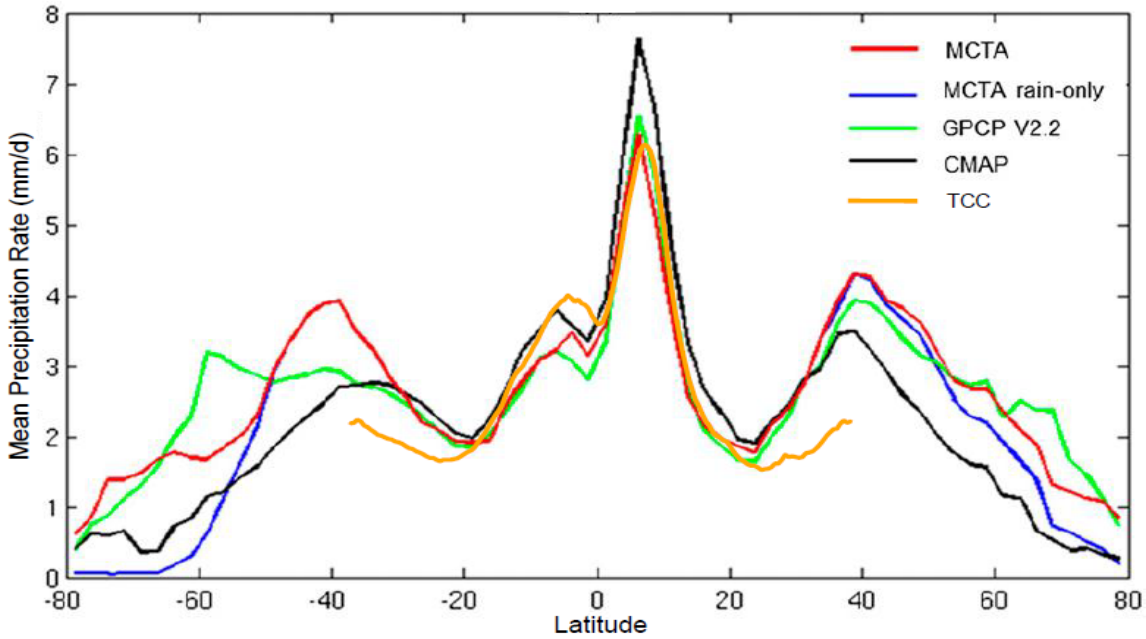
**Reference:**
**A. Behrangi,** A. Gardner, J.T. Reager, J. B. Fisher: Using GRACE to constrain precipitation amount over cold mountainous basins, *Journal of Geophysical Research Letters (in review)*

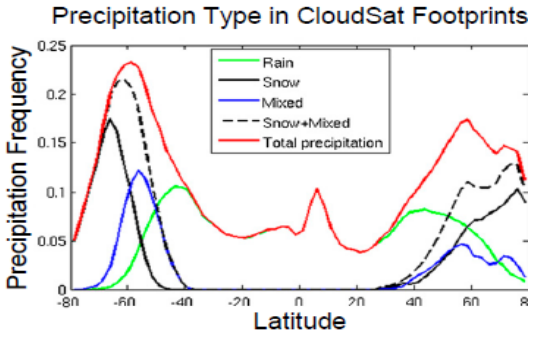
**Supported by:** *NASA's Energy and Water Cycle Study* ***(NEWS)(J. Entin) and GRACE (L. Tsaoussi)*** *programs*


Precipitation rate (mm/month)
Basin 1
(b)
TRMM 3B42 V7
TRMM 3A25
TRMM 3B42 RT
GPCP
APHRODITE
GPCC
GRACE
Time
0
30
60
90
120
150
180
2003
June
2004
June
2005
June
2006
June
2007
June
2008
June
2009

# Converging to the "Real" Oceanic Precipitation

## Using TRMM/GPM and CloudSat to Update the Oceanic Precipitation quantification and distribution




**How much rain and snow fall over the oceans? In the tropics, two recent composite climatologies and a modern climate-scale product agree quite well, and generally agree with a second climate product. At higher latitudes, snow becomes important and the satellite estimates are less certain; the Southern Ocean (south of 40°S) has the largest discrepancies. GPM is starting to provide important new insights in this region.**

**Behrangi, A.,** G. Stephens, R. F. Adler, G. J. Huffman, B. Lambrigtsen, and M. Lebsock, 2014: An Update on the Oceanic Precipitation Rate and Its Zonal Distribution in Light of Advanced Observations from Space. *Journal of Climate*, **27,** 3957-3965.